

Hawthorne Bridge
Spanning Willamette River on Hawthorne Boulevard
Portland
Multnomah County
Oregon

HAER OR-20

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HISTORIC AMERICAN ENGINEERING RECORD

HAWTHORNE BRIDGE HAER OR-20

Location: Spanning Willamette River on Hawthorne Boulevard and Madison Avenue,
Portland, Multnomah County, Oregon
UTM: Portland, Oregon Quad. 10/525835/5039810

Date of Construction: 1909-10

Structural Type: Vertical lift bridge

Engineer: Waddell & Harrington, Kansas City, Missouri

Fabricator: Pennsylvania Steel Company, Steelton, Pennsylvania

Builder: Superstructure--United Engineering & Construction Co., Portland, Oregon
Substructure--Robert Wakefield & Co., Portland, Oregon

Owner: City of Portland, Oregon, 1910-13
Multnomah County, Oregon, 1913-present

Use: Vehicular and pedestrian bridge

Significance: The Hawthorne Bridge is the oldest extant highway bridge in Portland, Oregon. It was designed by J.A.L. Waddell, at that time America's pioneer in major vertical lift bridges, and was the third major vertical lift bridge built in the United States. Waddell's two earlier vertical lift bridges, the South Halstead Street Bridge in Chicago (1892), and the Keithsburg Bridge in Keithsburg, Illinois (1910), have been replaced, thus making the Hawthorne Bridge the oldest extant major vertical lift bridge in the United States.

Project Information: Documentation of the Hawthorne Bridge is part of the Oregon Historic Bridge Recording Project, conducted during the summer of 1990 under the co-sponsorship of HABS/HAER and the Oregon Department of Transportation. Researched and written by Gary Link, HAER Historian, 1990. Edited and transmitted by Lola Bennett, HAER Historian, 1992.

Related Documentation: See also HAER OR-55, Willamette River Bridges.

HISTORY

The first bridge built at the location of the Hawthorne Bridge was a wooden swing span of the Pratt truss design, connecting Madison Street and Hawthorne Avenue, and was called the Madison Street Bridge. It was owned by the Madison Street Bridge Company and built by the Pacific Bridge Company. It opened January 11, 1891 as a toll bridge. On November 11, 1891 the City of Portland bought the bridge and abolished tolls on it. It was of poor design and was badly buffeted by the the streetcars of the Mt. Tabor Railway Line. In 1900 the bridge was replaced by another wooden swing span, the last wooden bridge built across the Willamette River in Portland, the second Madison Street Bridge. This bridge had six Howe truss spans, each 190 feet long and a 312-foot long swing span. When fully opened, it provided 150 feet of lateral clearance for river traffic. Its piers were comprised of two connecting sheet iron cylinders, filled with concrete and founded on piles.¹

In 1902 a major fire that burned several blocks of east side riverfront buildings swept across the Madison Bridge's east approach. Portlanders finally recognized the need to build steel bridges rather than wooden ones. In June 1907, voters authorized a bond issue of \$450,000 to build a new bridge at Madison Street.² In the summer of 1909 contractors began construction on the third bridge at Madison Street and Hawthorne Avenue--this one to be called the Hawthorne Bridge. It was a steel vertical lift bridge designed by the firm of Waddell and Harrington, consulting engineers from Kansas City, Missouri.

DESCRIPTION

The Hawthorne Bridge consists of five secondary spans and one vertical lift span. Starting on the west side, the first span is 246' long, the lift span is 250' long, and the remaining secondary spans are 246', 213', 213' and 212' long. The piers are reinforced concrete shafts resting on concrete bases which are founded on piles. The deck is steel grid. The steel superstructure is painted yellow ochre. Approaches connect the bridge on the west side to Madison Street, Main Street, and Front Avenue. On the east side the bridge connects to Hawthorne Boulevard, Water Avenue and Union Avenue.³

The lift span of the Hawthorne Bridge can raise 110' for a vertical clearance of 160 feet at mean low water. The span may be lifted to full height in less than one minute. The width of the truss is 23', center to center, for an inner roadway clearance of 20'. Traffic lanes also run along the outside of the truss, one on each side, with widths of 12' each. Along the outside roadways run wood-plank pedestrian sidewalks which are 6' wide. The lanes and sidewalks outside the truss are supported by cantilevered floorbeams. The machinery house is located atop the center of the truss; just below is the operators house, suspended above the roadway deck for a clear view of traffic in both directions. When first built, the total weight of the lift span was 885 tons including flooring and machinery.⁴

The lift towers rise 167' from the piers to the center of the main sheaves. The tower posts rest on the piers and the inclined back legs are attached to the truss of the adjacent fixed spans. Each tower weighs 128 tons. In each tower is suspended one concrete counterweight. Each counterweight is made of 200 cubic yards of concrete built around steel frames and originally weighing 442 tons. Auxillary concrete pieces weighing 1,500 lbs. may be added to either the counterweight or the lift span for balance. Each counterweight is 21' wide, 37'-3" high; and 6'-10" thick. Each is suspended by twenty-four cables, twelve on each end, which pass over the 9-foot diameter main sheaves (large pulleys) atop the tower. From there the cables pass down to hanger posts at the ends of the truss, where they are attached to equalizers which distribute the loads of the cables equally.⁵

Two 125-horsepower motors operate the lift span. Either one has sufficient power to operate the span alone. The motors operate two main shafts, each having at its end two 3½-foot drums which wind the operating cables. From these drums the cables run out to the ends of the truss. There, the cables which lift the span (uphaul cables) pass under sheaves then up the tower posts to connections near the top. The cables which lower the span (downhaul cables) pass over sheaves at the end of the span, then down to connections near the bottom of the tower posts. These connections have turnbuckles for adjusting the tension of the cables. During the movement of the span, the counterweights are stabilized by members riveted to their steel frames, which project out and engage guides in the tower posts. The lift span is stabilized by spring-loaded rollers at the top and bottom of the truss which run inside guides along the tower posts.⁶

The description of the secondary span trusses and road-decks follows the same as the lift span, except that the sidewalks of the secondary spans are made of concrete. The seven piers are made of reinforced concrete and rise 100' from the seals at their foundations. The piers are supported by concrete-filled timber caissons, founded on timber piles.

CONSTRUCTION

The Hawthorne Bridge was designed by Waddell & Harrington, Consulting Engineers from Kansas City, Missouri, a firm which held the patent for the vertical lift design. The Pennsylvania Steel Company of Steelton, Pennsylvania, fabricated the steel superstructure, which was erected by the United Engineering and Construction Company of Portland. Robert Wakefield & Company of Portland constructed the substructure.

The concrete bases and piers were built in open-crib cofferdams. Piles were driven through the cribs then cut off and sealed. The seal was poured underwater by using a long hose, called a tremie, to pass the concrete directly to the crib. After the seal was poured the water was pumped out of the cofferdam and the rest of the pier was poured in open air.

The fixed spans were erected in place. In order to keep the channel clear for river traffic, the lift span was erected downstream on falsework. When the span was completed, certain bents of the falsework were removed and three barges floated under to carry the span into place. Falsework was also built on top of the barges 45' high to elevate the span sufficiently to clear the piers. Once the barges were in place at the bridge, water was let into their bottoms in order to lower the span onto the piers. After the span was in place and attached to the cables and tower guides it was immediately lifted to clear the channel while adjustments were made.⁷

To construct the bridge, nearly 6 million pounds of structural steel and 16,200 pounds of reinforcing steel were used. Concrete for the counterweights, piers and bases totaled over 10,000 cubic yards. 42,149 linear feet of piles were driven for the bases, approaches and dolphins. The steel cables for the operating ropes and counterweight ropes weighed over 31,500 lbs.⁸

RENOVATIONS

The steel superstructure of the Hawthorne Bridge remains essentially unchanged from the original. Much work, however, has been done on the roadway deck and approaches. The original deck was wood planking that allowed water to seep through, resulting in almost constant maintenance. In 1931 the bridge was redecked, moving the streetcar rails from the lanes outside the truss to the inner lanes. In 1941 the west approaches were raised as part of improvements connected with Harbor Drive, a roadway which no longer exists.⁹

In 1945 the entire bridge deck was replaced with steel grate. Also, one foot of width was taken from the sidewalks and added to the outer lanes. In 1956 through 1959 approaches on both sides were totally reconstructed. The east ramp to Grand Avenue was raised to clear Water Street

and temporary trestles built to connect the bridge to Union and Grand Avenues. This work anticipated a planned interchange with the Marquam Bridge. After these plans were discarded, these trestle ramps became permanent.¹⁰

In 1985 inspectors discovered cracks in the main sheaves. Multnomah County closed the bridge for emergency repairs which lasted to the following August. All eight sheaves were replaced. Guides which stabilize span movement were upgraded, as were the cable equalizers. In the machinery house, the shafts and all but three gears were replaced. Also, a chain was added to balance the shift of the weight of the cable system during span movement.¹¹

ENDNOTES

1. "Lift-Span of the Hawthorne Avenue Bridge, Portland, Oregon," Engineering Record 63 (April 8, 1911) p.381; Fred Lockley, History of the Columbia River Valley from The Dalles to the Sea (Chicago: S.J. Clarke, 1928), p.537; E. Kimbark MacColl, The Shaping of a City: Business and Politics in Portland, Oregon, 1889 to 1915 (Portland: The Georgian Press, 1976), pp.149-153; Percy Maddox, City on the Willamette: The Story of Portland, Oregon (Portland: Binford & Mort, 1952), p.180.
2. MacColl, p.345; Sharon Wood, The Portland Bridge Book (Portland: Oregon Historical Society Press, 1989), p.37.
3. Multnomah County (Oregon), "Bridge Operation and Maintenance: Hawthorne Avenue Bridge, Portland, Oregon," Final Record Drawing, 1913; Wood, p.42.
4. "Lift-Span of the Hawthorne Avenue Bridge, Portland, Oregon," Engineering Record 63 (8 April 1911), p.381.
5. W.P. Hardesty, "The New Hawthorne Avenue Bridge at Portland, Oregon," Engineering News 65 (9 March 1911), p.279.
6. Bart Bonney, interview, July 11, 1990.
7. "Lift Span of the Hawthorne Avenue Bridge, Portland, Oregon," Engineering Record 63 (8 April 1911), p.381.
8. Multnomah County, Final Record Drawing, 1913.
9. Herbert K. Beals, National Register of Historic Places Nomination Form, "Hawthorne Bridge," 1986; Jack Ostergren, "Hawthorne Bridges Take Punishment From City's Storms," Oregon Journal, 2 July 1968.
10. Bonney, Interview, 20 August 1990; "How the Hawthorne Bridge, Portland, Got Its Face Lifted," Pacific Builder and Engineer 51 (November 1945), pp.44-45.
11. Bonney, July 11, 1990; Oregon Department of Transportation, Environmental Section, Maxine Banks, Memo to File, 27 June 1985.

ADDENDUM TO
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